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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 61.

B. T. GALLOWAY, *Chief of Bureau.*

THE AVOCADO IN FLORIDA;

ITS PROPAGATION, CULTIVATION, AND MARKETING.

BY

P. H. ROLFS,

PATHOLOGIST, IN CHARGE OF SUBTROPICAL LABORATORY.

POMOLOGICAL INVESTIGATIONS.

ISSUED JULY 7, 1904.

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BULLETINS OF THE BUREAU OF PLANT INDUSTRY.

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[Continued on page 3 of cover.]

WEST INDIAN-SOUTH AMERICAN AVOCADO TREE, 35 YEARS OLD, GROWING ON A CORAL BRECCIA REEF.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 61.

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BUREAU OF PLANT INDUSTRY.

BEVERLY T. GALLOWAY, *Chief.*

J. E. ROCKWELL, *Editor.*

POMOLOGICAL INVESTIGATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., April 7, 1904.

Sir: I have the honor to transmit herewith a paper on "The Avocado in Florida; its Propagation, Cultivation, and Marketing," and respectfully recommend that it be published as Bulletin No. 61 of the series of the Bureau.

This paper was prepared by Prof. P. H. Rolfs, Pathologist in Charge of the Subtropical Laboratory at Miami, Fla., under the direction of Dr. A. F. Woods, Pathologist of this Bureau, but as the subject is pomological rather than pathological, it was submitted to the Pomologist with a view to its publication from his office.

The accompanying illustrations are essential to an intelligent understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

The avocado (*Persea gratissima*) is one of the most recent fruits to receive intelligent and systematic treatment from American fruit growers. Though long held in high regard by persons living in southern Florida, the West Indies, and most portions of tropical America, it has not until recently attracted the attention of northern consumers, and is, in fact, at this time an interesting novelty rather than a recognized staple of commerce. This is probably due to the fact that it lacks those characteristics of texture and flavor which are sought for in most dessert fruits, so that a taste for it must be acquired by most persons. In recent years, however, its usefulness as a salad fruit has gradually been recognized, so that a growing appreciation of its value in this regard has led to an increasing demand for it in our larger cities.

Until very recently the principal supply for these markets has come from the West Indies, chiefly because of cheaper transportation from those islands than from Florida. The recent extension of railroad facilities to far southern Florida has made possible the safe shipment of this fruit from that section to practically all parts of the country, and interest in its commercial culture there has therefore largely increased.

As it provides a wholesome and nutritious food, which, judging from present demand and prices, will afford a profitable crop in locations suitable to its production, its culture on a commercial scale appears worthy of encouragement in Porto Rico, southern Florida, Hawaii, and such locations in California as are practically free from frost during the blossoming season.

The greatest need at present appears to be the propagation of productive varieties of desirable size, form, and quality, ripening at an opportune time—that is, late in autumn or early in winter, when the demand in northern markets at high prices appears to be best. As the bud propagation of this fruit in a commercial way has but recently commenced, it is believed that this publication, which deals largely with that subject, will be of distinct value to those who desire to engage in its production.

G. B. Brackett,
Pomologist.

Office of the Pomologist,
Washington, D. C., March 29, 1904.

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THE AVOCADO IN FLORIDA; ITS PROPAGATION, CULTIVATION, AND MARKETING.

INTRODUCTION.

The avocado (*Persea gratissima* Gärtn.) might almost be called a new fruit, for, while it has long been used as a food by the American aborigines, it has never been subjected to cultivation and careful breeding. Its value as a food is rapidly becoming known, and it is apparently only a question of time until it will be used extensively. Its shipping qualities permit it to be sent to all the large consuming centers of the United States, while its food value will make it a favorite with all lovers of good salad fruits. These pages have been prepared with a view to systematizing our knowledge of the avocado, and to point out the directions for its improvement.

South Florida seems to be the only region in which the propagation of the avocado has been undertaken in a systematic way and on an extensive scale. Nurseries in that section have thousands of seedlings growing and hundreds of budded trees to put on the market. In addition to this, it seems to be the only region where budded trees have fruited.

The Pollock avocado, grown in South Florida, was exhibited at the meeting of the American Pomological Society in September, 1903. The original tree bears fruit of large size, the largest having approximated 3 pounds in weight. The Trapp avocado, also grown in South Florida, is noteworthy in that it matures late, holding some of its fruit until January.

The essential work of selecting and breeding varieties that are especially adapted to certain sections and that are wanted by the most desirable markets can now be pushed forward.

The fact that it can now be definitely stated that seedlings do not come true to seed and that propagation by budding is possible marks a distinct epoch in the progress of growing this fruit. Another distinct advance in the development of this salad fruit is that seedless fruit has been grown by the writer.

The selling price of avocados varies considerably, the latest ripening ones bringing much the best prices in American markets. Extremely

late ones have brought as high as $3 a dozen when shipped in lots of several crates at a time. This price gives the grower $6 to $8 net per crate at the shipping station. The price for good fruit in sound condition has never fallen so low as to make it unprofitable to ship it to markets that use it. In many large cities in the United States the avocado can not be found at all, and as the dealers in Boston, New York, Washington, and New Orleans have been able to handle all the good fruit that has been sent to them, it is not probable that the avocado will be introduced into other centers until these markets have been fully supplied.

THE NAME AVOCADO.

This fruit has been called by various names—avocado, avocado pear, avocate, aguacate, alligator pear, midshipman's butter, etc. As early as 1696 Hans Sloane[a] speaks of the "avocado or allegator pear-tree" and catalogues about a dozen other names by which it is known in literature. Previous to this date the avocado was known from "Nicaraguae and other portions of the American continent."

Murray's New English Dictionary prefers the name avocado and gives the following reference:

> Taylor *Anahuac* IX, 227 (1861). This is a well-known West Indian fruit which we call an avocado or alligator pear, and which the French call "avocat" and the Spanish "aguacate." All these names are the corruption of the Aztec name of the fruit "ahuacatl."

Meissner[b] gives the following names as being used in various parts of America:

> In Peru, Palto and Aguacate; in Central America, Aguacate de Anis; in Mexico, Aguacate; in Brazil, Avocate; in Antigua and British Guiana, Avocado Pear and Alligator Pear; in French Guiana, Laurier Avocat.

The Florida State Horticultural Society[c] prefers the name avocado, while the American Pomological Society[d] gives preference to aguacate and uses avocado as second choice. When the Catalogue of Fruits shall be again revised, avocado will doubtless be given preference.

According to the Century Dictionary, avocado is a corruption from the Mexican. The addition of the word pear, while describing the shape of the fruit in some varieties, is otherwise inappropriate, since the avocado belongs to the laurel family, while the pear belongs to the rose family. How such a barbarism as "alligator pear" could have been perpetrated upon this salad fruit it is difficult to imagine. The name avocado is short, concise, and has the advantage of being largely used by the American growers of this fruit.

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[a] Catalogus Plantarum quae in Insula Jamaica Sponte Proveniunt, Pars Prima, London, 1696, p. 185.

[b] Martius, Flora Brasiliensis, Vol. V, pt. 2, fasc. 41, p. 159.

[c] Transactions, 1902, p. 20.

[d] Proc., Am. Pom. Soc., 1901, Part II, p. 59.

Mr. C. P. Taft[a] says of the avocado in California:

The avocado, or alligator pear, is destined to receive more and more attention as it becomes better known. It is fairly hardy, and a good grower and bearer. Importations from Mexico are frequent in the Los Angeles markets, where they sell for fancy prices.

Mr. A. A. Boggs[b] says:

The avocado or alligator pear (*Persea gratissima*) is already growing rapidly in favor in a few of the larger cities where people are beginning to learn its superior excellence as a salad fruit, and it bids fair to become an important market crop. It has, however, been grown entirely from seed, and as it varies widely in size and quality, there is urgent need of improvement in method of propagation. All efforts to bud or graft have hitherto proved abortive. The Department of Agriculture made an importation of seed of a Mexican variety about three years ago. Some trees from these have already come into bearing, and proved a disappointment. The fruit is entirely too small and the flavor certainly not superior to the average of the old type.

Mr. Byron O. Clark[b] says of this fruit in Hawaii:

The avocado or alligator pear is the one fruit which captures the palate of the visitor to the Tropics more firmly than any other, provided he acquires a liking for this fruit. With the richness and consistency of butter, and a flavor of nuts, it is undoubtedly one of the most popular fruits, if not the most popular with residents, and acquires such popularity with persons who visit the islands that a good market for shipment to the coast is open at any time the fruit can be had. Like almost all other kinds of fruit here, the home market is not nearly supplied, and the prices are so high that none but the wealthy can use them, except as a luxury.

LITERATURE.

Very little has been written about the propagation of the avocado. It was introduced into Europe as early as the seventeenth century, but has not yet been generally disseminated. Simmonds's "Tropical Agriculture" does not mention it at all. Woodrow's "Gardening in India," published in 1899, does not refer to it.

Dr. F. Franceschi[c] speaks of its having fruited in southern California. He also points out that the demand for it in the larger cities of the United States is greater than the supply.

In 1899 Capt. John J. Haden[d] exhibited fruit of the avocado in Philadelphia.

The Botanical Register of 1829 published a colored plate of this fruit (No. 1258), and referred to it as having been introduced from the continent [America], and as one of the rarest species cultivated in the greenhouses.

Curtis's Botanical Magazine for May 1, 1851, published a colored plate of an avocado presenting rather an unusual combination. The

[a] Proc., Am. Pom. Soc., 1901, p. 92.
[b] Proc., Am. Pom. Soc., 1901, p. 88.
[c] Proc., Am. Pom. Soc., 1897, p. 100.
[d] Proc., Am. Pom. Soc., 1899, p. 88.

figures of the branches, including the leaves and inflorescence, are undoubtedly the West Indian–South American form. The size of the fruit is that of the West Indian–South American form, while the color of the skin is exactly that of the Mexican avocado. This publication also suggests that "it is increased by cuttings, treated in the usual manner." So far as the writer's experience goes, the cuttings are difficult to strike without bottom heat.

In the Yearbook of the United States Department of Agriculture for 1901, page 354, Mr. O. F. Cook refers to the avocado as one of the important fruits of Porto Rico, and says:

> The alligator pear, also called butter pear, aguacate, and avocate, is a tropical fruit now relatively little known, but with every prospect of a gradually increasing popularity. It is a pear only in shape, and might better be compared to the olive, because it serves as a salad or a relish rather than a fruit in the ordinary sense, and frequently becomes a favorite, even with those who do not like it at first. The flesh has a delicate buttery consistency, and is eaten with vinegar, salt, and other condiments, or is used as an ingredient of other salad compounds. The promise of agricultural and commercial importance for this fruit lies in the fact that it already has a distinct, if limited, place in the markets of our larger cities at from 30 to 60 cents apiece, prices which might be halved or quartered and still leave good profits for both grower and dealer. Moreover, even at these large prices the supply of first-class fruit seems to be unequal to the demand.
>
> The alligator pear is perhaps the one fruit which Porto Rico is ready to send to market in considerable quantity and of prime quality. The tree is easily propagated from seed, is a vigorous grower, and a free bearer, and there is no apparent reason why the alligator pear may not become almost as cheap and nearly as popular as the orange.

In the Report of the Florida State Horticultural Society for 1902, Mr. Boggs says:

> Of equal promise and of greater present market importance is the avocado pear, which is to-day the most costly fruit on the American market, and is making more friends every season. The importance of budding and grafting as applied to this fruit is greater than the securing of better varieties from abroad, for Florida now produces the best in the world, but in eliminating the inferior sorts which form a large proportion of seedling orchards and in regulating by selection the season of fruitage. There are now trees in Dade County which ripen fruit as early as July 15 and others as late as January 15. The significance of this fact needs no comment.
>
> Choice avocados retailed last season at from 35 cents to 75 cents each in the cities, and the demand seems to outgrow the supply. It is urged that this society, in its catalogue, should encourage the use of the name avocado, both on the score of correctness and of euphony, in place of the absurd misnomer "alligator pear," which leads to many mistakes.

Mr. W. A. Marsh also makes reference to this fruit in the Report of the Florida State Horticultural Society for 1896, as follows:

> The alligator or avocado pear (*Persea gratissima*) is one of the most highly prized of all tropical fruits. It belongs to the order of Lauraceæ. The fruit is sometimes round, also pear-shaped, containing one large seed about the size and shape of a hulled walnut. The fruit when mature varies in color from a bright green to a deep rich brown, sometimes mottled with both colors. Its flesh is a vegetable marrow,

sometimes called midshipman's butter, and held in various degrees of appreciation by different persons. It is also used as a salad, being dressed with pepper, salt, and vinegar, in which style it is relished by most people. The tree is of stately growth, often reaching the height of 40 or 50 feet in Florida. It is an American fruit; it was introduced into the gardens of Spain in 1601, and into the Sunda Isles about the middle of the eighteenth century. At the beginning of the eighteenth century this tree did not exist in the gardens of British India. In America its actual area in a wild state is of uncommon extent. It has been found in the forests, on the banks of rivers, and on the seashore from Mexico and the West Indies to the Amazon. At the time of the discovery of America it was found both wild and cultivated in Mexico. According to Hernandez it was cultivated by the people of Peru under the name of "palto," but there is no proof that it was wild in that country.

Mr. W. Harris refers to it in Bailey's Cyclopedia of American Horticulture as follows:

The avocado or alligator pear is a native of the West Indies, Mexico to Peru, and Brazil. It is very common in Jamaica, being found in every settlement or plantation. The tree grows to a height of 25 to 30 feet. It has elliptical or elliptical-oblong leaves, 4 to 7 inches long, glabrate and pale beneath. The fruits are large, more or less pear-shaped, and covered with a green or deep purple skin and containing a large quantity of a firm yellowish-green pulp, inclosing a single large seed. This fruit is highly esteemed by all classes in the West Indies. The pulp is marrow-like, and is eaten as a salad, usually with the addition of pepper, salt, and vinegar. Europeans as a rule do not like the fruit at first, but once the taste is acquired they become exceedingly, often excessively, fond of it. The pulp contains an abundance of oil, which may be used for illuminating purposes; also for soap making. The seeds yield a deep, indelible black stain, and are used for marking linen. Plants are easily raised from seeds, and in good soil in warm situations they grow rapidly and begin to fruit when about 5 years old. There are a good many varieties, differing from each other in size, shape, and quality of fruit. These differences are not due to careful cultivation and selection in all cases, however, but to natural variation and accidental intercrossing.

DISTRIBUTION AND TIME OF BLOOMING.

Meissner[a] gives the habitat of the avocado as "the forest, especially on the seacoast and following the rivers of tropical America, as well as in Mexico, Peru, Colombia, Guiana, and the islands of the Antilles, thence to subtropical localities where this agreeable fruit is cultivated. It is found in Brazil, about Peru, and elsewhere; also about Yurimagnus, in Peru, and in English Guiana."

Emile Rodigas[b] thinks that the avocado is native to Brazil. He figures a large green fruit without a seed cavity. It is interesting to note that according to this author it was introduced in France in 1750.

An herbarium specimen in the New York Botanical Garden, collected by Mr. H. H. Smith, in Colombia, is accompanied by a note stating that the species has every appearance of being native to the mountain forest at an altitude of from 1,500 to 2,500 feet. The time

[a] Translation from Martius, Flora Brasiliensis, Vol. V, Part II, p. 159.

[b] L'Illustrations Horticole, XXXVI: 15 (1889).

of blooming is given as from December to April. The specimen is in full bloom and bears the date of December 7, 1898.

Dr. William Trelease, Director of the Missouri Botanical Gardens, who has made repeated excursions to Mexico in connection with the study of agaves, informs the writer that the smaller avocado with the bluish or blackish fruit (the Mexican avocado) is most commonly found in the markets on the eastern side of the country, while the larger forms occur on the western slope.

Specimens in the herbarium of the New York Botanical Garden and in the United States National Museum indicate that the avocado has been widely disseminated. Among those occurring in the herbarium of the New York Botanical Garden are some collected at the following places and on the dates given, which are of special interest: Colombia, December 7, 1898; Nassau, N. P., March 12, 1903; Key Largo, Fla., March 26–29, 1898; island of Saint Croix, March 4, 1896; Porto Rico, March 8, 1899; Porotonga, Cook Islands, June, 1899; Monterey, Mexico, January 10, 1828; San Luis Potosi, Mexico, 1879; Nicols Town, Andros (Bahamas), March 24, 1890; St. Vincent, British West Indies, April, 1890; Java, 1865; Jamaica, 1827. The following specimens were found among those in the herbarium of the United States National Museum: Martinique, 1871; Danish West Indies, March 4, 1896; Santo Domingo, March, 1871; Colima, Mexico, March, 1841.

The foregoing fifteen localities from which specimens of this species have been collected show how widely it has been distributed. The fact that specimens were collected in Java as early as 1865 shows that the plants had been imported a considerable time previous to that date. While no specimens from the Hawaiian Islands were found in the herbaria referred to, it is well known that the species occurs there in large quantities. It is also said to occur in the Seychelles Islands and in Madagascar, and it is doubtless found in all other tropical islands, and to some extent on the seaboard of almost all tropical countries.

The herbarium specimens referred to give some interesting information regarding the time of blooming. Those collected in Colombia show a date of blooming of December and January, while a note upon one of the herbarium sheets indicates that the time of blooming extends from December to April. In Mexico the period of blooming seems to be about the same as in Colombia. In the West Indies, except the Bahamas, the earliest bloom may occur as early as February, but the season of bloom closes in April. In the Bahamas and Florida the flowers usually appear about the first of March, though sometimes blooms occur as early as February, while the blooming period closes in April.

The season near the equator appears to be lengthened into five months. A shortening of the period of blooming seems to have

occurred by crowding the entire period into the last two months when the species is taken to the northern limit of its zone. Some allowance must be made for variations that occur from year to year, but this does not amount to more than two or three weeks in South Florida. The commercial importance of having this fruit come into the market as late in the season as possible and in considerable quantity can not be overestimated.

THE AVOCADO FOR WIND-BREAKS AND SHADE TREES.

Nearly every orchardist is confronted with the necessity of securing good shade trees about his premises, and especially a screen for outbuildings and for servants' houses. In addition to shade the question of wind-breaks is of great importance where high winds are almost certain to occur every year. The vigorous-growing varieties of avocados meet these needs as satisfactorily as the purely ornamental trees, and in addition may be expected to give a return of fruit. The fact that the avocado can utilize almost any kind of organic fertilizer without becoming diseased makes it much more desirable for these purposes than mangoes and citrous trees. The tall, sturdy growth makes free pruning of the lower limbs possible, so as to permit the passage of persons and animals under the trees, while the abundant growth of leaves will still produce a dense shade.

METHODS OF STARTING AN ORCHARD.

The general method of securing an orchard of avocados in Florida is to germinate seed in a quart or a two-quart tin can, and after the seedling has attained the height of a foot or two the can with its contents is transferred to the field where the tree is to grow. A still more primitive way of starting an orchard is to plant the seed in the soil where the tree is to stand. There is no great difficulty in starting an orchard in either way, since the largest seeds (fig. 1) weigh several ounces and have great vitality. If it does not happen to become infected by some germs of decay the seed may lie in the soil for an entire year awaiting a time favorable for germination. The unusual amount of nourishment stored up in the seed enables the seedling to make repeated starts after being dried off. It is capable of renewing its roots several times, as well as its top.

This method of starting an orchard is quite certain and inexpensive. When the trees are one or two years old they may be budded to any desired variety. While this is better than to await the uncertain results and certain disappointment of a seedling orchard, yet top-working is expensive, and if budded trees of known variety can be obtained from a good nursery they will be found cheaper in the end and much more satisfactory.

THE SEED BED.

Seed may be obtained in large quantities during the ripening season from southern Florida, Cuba, and other places in the Antillean region. At the present time good seeds cost from 1½ to 2 cents each. These prices seem somewhat high, but every seed is nearly certain to make a seedling.

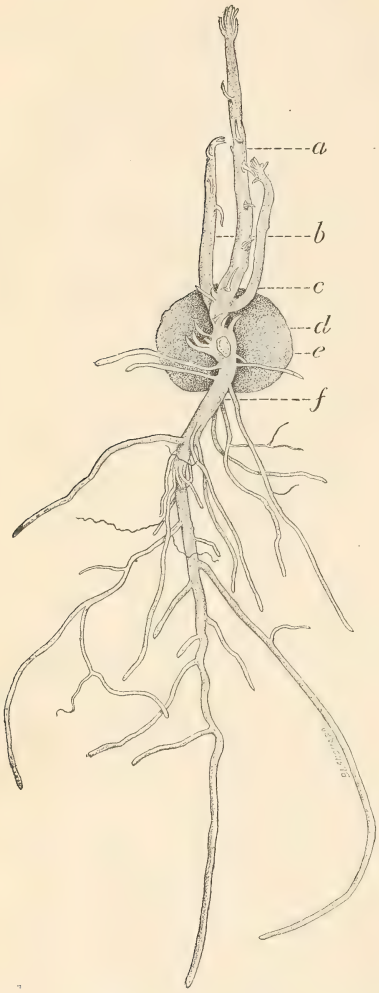

FIG. 1.—Seedling avocado in December from seed planted in September (somewhat slow in starting, but otherwise apparently normal): (*a*) First shoot to start; (*b*) second shoot starting from the axil of the incipient leaf; (*c*) third shoot to start—in case of severe drought or other adverse conditions, all of these shoots may fail and some other bud grow into a new shoot; (*d*) scale-like leaf; (*e*) one of the cotyledons, the other having been removed, scar opposite *e*; (*f*) primary root. (Reduced to one-third natural diameter.)

The seed bed should be made in some moist locality, in soil free from rocks and containing an abundance of vegetable matter. The rows may be made such distances apart as will suit convenience—from 1 to 4 feet. Place the seeds from 4 to 6 inches apart in a drill 3 or 4 inches deep; firm the soil about the seed and cover 2 or 3 inches deep. Supply a heavy cover of mulch.

As soon as the seedlings (see fig. 1) appear above ground, fertilizer may be applied. The mulch should be turned back, the fertilizer raked in or cultivated in, and the mulch replaced. If the seedlings are to be removed to the nursery soon, fertilizing and cultivating may be omitted. Removal to the nursery may be deferred until seasonable weather.

THE NURSERY.

For starting a nursery the best land should be selected, especially such as is fairly dry though never suffering from drought. Land that is subject to flooding should by all means be avoided. While the trees are able to live in standing water for two or three weeks, they become subject to attack by various forms of disease. When practicable, a generous application of fertilizer should be made two or three weeks before the trees are set out. It should be scattered down the row and raked in, in the usual way. The land should be thoroughly grubbed and put into a first-class state of cultivation.

Transplanting to the nursery should be done when the seedlings are 6 inches to a foot high. After this time the taproot (see fig. 1, *f*) will have formed and the transplanting will disturb this and prevent it from growing to the large size that it would attain if the seedling were not removed.

For transplanting, rainy weather should be chosen; otherwise much watering will be necessary or many trees will be lost. From the nurseryman's point of view the planting in a seed bed seems unnecessary, but seeds planted in a nursery produce trees with large taproots and few fibrous roots; this is especially the case on land that is more or less sandy.

In the nursery the rows should be from 4 to 6 feet apart and the trees set about a foot apart in the row. By thorough cultivation and generous fertilizing an abundance of fibrous roots will be produced, and if the nursery is located on moist land most of the trees will produce many branched roots and very few large roots.

CULTIVATION IN THE NURSERY.

After planting in the nursery, cultivation should be thorough and frequent. The implements should not be permitted to go deeply into the soil if it is sandy, but in marl or heavy lands cultivation should be as deep as is practicable.

BUDDING.

There have been many and varying reports regarding the possibility of budding and grafting the avocado. A few years ago it was thought impossible to bud it at all. More recently statements have been made that 90 to 100 per cent of the buds had "taken." These reports when investigated have been only partially verified, since a large percentage of the buds that take fail to develop. In the avocado there seems to be no difficulty in making the buds take, but there is considerable difficulty in making them start. The buds placed in a vigorous stock are frequently grown over, thus obliterating the bud. Or again, the stock on being lopped to induce the bud to start often dies back to below the bud. Experience indicates that budding at or near the crown is preferable to top-working.

The difficulty is not with budding but with the want of experience up to the present time. The nurserymen do not fully understand the time and manner best suited for budding their stock. Some buds respond promptly, while others are very dilatory about starting and may finally fail.

Shield buds (fig. 2) inserted in the spring when the bark slips well and before the first flush, usually take well and make an excellent growth. It is very important in the work of budding that the stock and scion be in as perfect condition as possible. (See figs. 3 and 4.)

Bud sticks (fig. 5) are cut from well-matured growth, especially such as shows an abundance of active buds. (See fig. 5, *a*, *a*, *a*.) Wood with many blind buds (see fig. 5, *b*, *b*, *b*) should be avoided and care taken not to use such buds in propagating. Some are likely to occur on any stick.

Various methods of budding have been adopted and some forms of grafting have been suggested. The common shield bud (fig. 2) seems to be about as successful as any that have been tried, though the patch bud is also used with a considerable degree of success.

FIG. 2.—Shield bud cut out preparatory to insertion.

FIG. 3.—Seedling avocado stock with shield bud inserted.

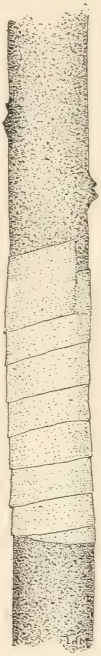

FIG. 4.—Shield bud wrapped with waxed cloth.

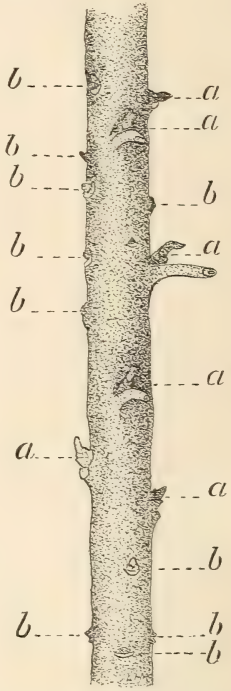

FIG. 5.—Bud stick; *a*, *a*, etc., "live" buds in various stages of development; *b*, *b*, etc., blind buds which should not be used.

GRAFTING.

Baltet[a] recommends four different methods of grafting: (1) Inarching, (2) veneer grafting, (3) cleft grafting, and (4) veneer grafting near the root. In inarching and cleft grafting the top of the stock is figured as having been cut away. In the other two methods the top of the stock is left until the scion has started. Well-matured wood will live for several weeks if kept in a sufficiently moist condition, and will doubtless unite readily with the stock, but it is much more wasteful of scion wood and a more tedious process than budding.

[a] L'Art de Greffer, 7th ed., Paris, 1902, p. 226.

TRANSPLANTING TO THE FIELD.

A great deal of the difficulty that has been experienced in transplanting the avocado is due to the fact that most of the trees have been grown in "fence corners," or possibly they have been permitted to grow under the tree where the seed fell, thus producing tall, slender seedlings, with very few branches and long taproots, but not many fibrous roots. A very different result is obtained from trees grown in a nursery (see Pl. III), where, as previously stated, an abundance of fibrous roots and a good bushy top are produced. A tree of this kind transplants without any greater difficulty than is experienced with other orchard trees.

One hundred budded trees to an acre are sufficient. If the grower proposes to have a seedling orchard the trees should be set closer—160 to 200 per acre. This should be done with a view to cutting out the inferior ones when they come to fruiting. Of the large-growing varieties 80 trees to the acre will be found sufficient. If the variety is tall and spindle shaped instead of bushy, a larger number may be planted.

In the Antillean region trees grow during the entire year, so there is no sensible gradation into winter or anything that corresponds to a dormant season, strictly speaking. While fruit trees are usually in a more or less quiescent state during January and February, this condition is brought about by a diminution in rainfall rather than as the result of a reduction in temperature.

The time to transplant avocados is determined, as in the case of the nursery, by the presence of sufficient moisture, and a suitable moist period will usually occur in Florida during June, July, or August. As the expense of watering during a dry season is much greater than the cost of the tree it is cheaper to set the tree out during a rainy season.

A tree should not be transplanted until it has attained a height of about 3 feet in the nursery (see Pl. III).

In taking up these trees as many of the smaller roots should be secured as possible. The roots should be kept moist and the tree well watered when set out. The top should be cut back to some extent, but enough foliage left to shade the stem. If the tree is not sufficiently provided with leaves an artificial shade can be made by the use of palmetto fans.

TOP-WORKING TREES.

Bearing trees may be top-worked (see Pl. II, fig. 2), but it is necessary to insert buds on vigorously-growing sprouts to succeed. If there are no sprouts with bright green bark, they may be induced to grow by cutting back the branches and thus stimulating some of the

latent buds, or by cutting the trees off near the ground and then waiting for sprouts to start from the crown. Several of these sprouts are then budded and the most vigorous of those that have taken are permitted to grow (see Pl. II, fig. 1).

CULTIVATION.

When the trees are set in the field a considerable quantity of mulch should be placed about them; this prevents the soil from becoming hot about the roots and from drying out.

In Florida it is better to plant some field crops, such as cowpeas or velvet beans, or to sow beggar weed in a young orchard. During the winter, crops of vegetables may be grown in the orchard with advantage to the trees. The "middles" may be planted to pineapples, since the pineapple fertilizer will produce a good growth of avocado; but there is the disadvantage that these plants will dry out the soil severely during a drought. During dry weather cultivation should be frequent and thorough, but not deep; 3 inches of soil mulch is sufficient to conserve capillary moisture. During the rainy season cultivation may be suspended entirely and the middles planted to some cover crop, as indicated above.

FERTILIZERS.

In selecting fertilizers a formula should be chosen in which the ammonia is from an organic source, such as dried blood or cottonseed meal, in preference to sulphate of ammonia or nitrate of soda. Sulphate of potash will be a safe form to employ as a source of potash. It should be used in liberal quantities to insure good firm leaves and wood, and also to prevent the dropping of the fruit. Phosphoric acid, so far as experiments teach, may be supplied from any source that is ordinarily used. If the trees be planted about poultry yards, or fowls are allowed to roost in the trees, potash will be all the fertilizer needed, but this should be used liberally to keep the trees healthy and free from insect attacks. Such trees when not fertilized with potash are usually attacked by insect pests, but as a rule are exempt from Glœosporium.

When commercial fertilizers are to be applied, the ordinary "fruit and vine" fertilizer, with the ammonia from an organic source, may be used. The quantity required will vary according to the concentration of the particular brand, the character of the soil in which the trees are growing, and the age of the trees. Fifteen pounds per tree per year of fertilizer prepared according to the following formula will be found good for growing trees four or five years old: Ammonia, 5 per cent; potash, 6 per cent; phosphoric acid, 6 per cent.

As the trees grow older and begin to fruit heavily, increase the percentage of potash and phosphoric acid. Apply the fertilizer in two or three doses during the growing season. The time of applying must be determined by the particular orchard under consideration; ordinarily an application should not be made during December or January, as it would be likely to force an early spring growth or even cause a vigorous winter growth, which should be avoided.

If the trees be put into a dormant or semidormant condition during December and January, they will make a strong spring growth and produce a heavy crop of bloom. If the bloom is retarded as long as possible the blooming period will be shortened, and consequently the fruit will mature more nearly at one time, thus doing away with the necessity of making several pickings from the same tree.

Trees that have been neglected do not prove productive unless they happen to be standing on some place where a large quantity of organic matter has accumulated. Trees on abandoned homesteads located in the piney woods soon become unproductive and require two or three years' nursing to bring them back to good growth and bearing. It usually pays better to start in with good, fresh trees from the nursery than to attempt to "bring out" an abandoned orchard.

SUPERIORITY OF BUDDED TREES.

The earlier productiveness of orchards composed of budded and grafted trees has been repeatedly demonstrated with most of the tree fruits that are grown under cultivation. While occasional seedling trees of most species bear at as early an age as the ordinary budded or grafted tree of the same species, the trees in a seedling orchard usually vary greatly in this particular, and on the average come into bearing much later than budded or grafted orchards of varieties of the same types of fruits grown under similar conditions. While many factors are concerned in producing this result, the greatest advantage of budding and grafting is that varieties of known precocity and productiveness, as well as other desirable characteristics, can be perpetuated with little variation, while the seedling orchard contains individuals differing widely in some or all of these important particulars.

Seedling avocados usually do not fruit until they are four or more years old, and they are usually six years old before bearing a crop. There are exceptions to this, but the number of seedlings that bear a good crop before they are six years old will not amount to 10 per cent.

VARIATION OF FRUIT FROM SEEDLING TREES.

The systematic work of propagating and cultivating avocados is just beginning. The fruit being of American origin, it has come into cultivation rather recently, and has not had the benefit of centuries of

selection and propagation, as is the case with many other orchard fruits. Throughout Central America and the West Indies it grows in a native state, and only half-hearted attempts are made to put it into cultivation. So far as the writer is aware, no orchard of any considerable size exists outside of Florida. In Cuba, Jamaica, Porto Rico, and the Bahamas a few seedling trees are growing around nearly every settler's place. The owner plants the seed and takes his chances as to the character and fruitfulness of the tree. Under these conditions a considerable quantity of fruit is being grown and marketed, but the product is of an exceedingly variable nature. The two following illustrations prove the truth of this statement.

DESCRIPTION OF VARIATIONS.

Mr. G. L. Macdonald, of Cocoanutgrove, Fla., related his experience to the writer. In preparing for his orchard Mr. Macdonald selected the seed from a tree that bore fruit of exceptionally fine quality and in large quantity. At the time the selection was made it was generally believed that avocados came true to seed. The parent tree produces pear-shaped avocados of large size, fine flavor, and purple color, ripening late. The seedling orchard from this tree has now come into bearing and produces fruit of variable size and shape; good, bad, and indifferent flavor; the color varying from green through yellow to purple; and the fruits ripening at different times in the season.

The following census, taken near Buenavista, Fla., in an orchard of about an acre in extent, shows how little foundation there is for the belief that the avocado trees are unusually fruitful and that the tree comes "true to seed." The impression that the tree is unusually fruitful doubtless originated from the fact that occasional trees bear a heavy crop (see Pl. III), causing the observer to overlook the dozens of trees that have less than ten fruits each or possibly none at all. The unfruitfulness and the variability of the product is not more than should be expected from an orchard of seedlings.

This orchard contains 160 trees, 110 of which are five or more years of age and of a size to permit the smallest to bear 50 fruits, weighing from a pound to one and one-half pounds each. This number of trees produced 1,161 fruits in 1903, a year during which the avocado crop was unusually heavy. This gave an average of approximately 10 fruits to the tree. Forty-seven trees bore no fruit at all; 41 trees bore from 1 to 12 fruits; 22 bore a crop of more than 12 fruits, 9 of these latter trees bearing 595 fruits, or slightly over half the crop. The four most prolific trees bore 385 fruits—that is, one-twelfth of the trees produced one-third of the fruit, or, stating the matter in percentages, 43 per cent of the trees produced no fruit; 37 per cent

produced 1 to 12 fruits each; 20 per cent produced over 12 fruits each.

Considering only the prolific trees, we find that 8 per cent of the trees produced 66 per cent and that 3 per cent produced 33 per cent of the fruit.

The nine trees that produced at least a fair crop were of medium size, while the largest and most vigorous trees in every instance bore less than a fair crop.

The trees referred to above were from specially selected seed, so that it may safely be assumed that they were up to the standard for seedling orchards of the same type that have received fair attention and are of the same age. Some of the trees that were without fruit this year had a fair crop last year, indicating a tendency on the part of the avocado to fruit in alternate years. The most fruitful trees are only moderately vigorous and of a bushy growth.

Of the 63 trees that have fruited in the orchard mentioned there are only 2 which combine good qualities in such a way as to be of special merit. Some trees that bear fine fruits are not prolific; others ripen their fruit at an inopportune time of the year, while still others bear a fair crop at the right time but the fruit is inferior in quality. (See figs. 6, 7, A; 8, and 9.)

If a census of all the seedling orchards were taken, it is not probable that the general results would be very different, but this is just what should be expected in propagating from seed a species that is so variable as the avocado.

MARKETING.

PICKING.

The time of ripening of the avocado extends in Florida from the middle of July to December. As now grown, the fruits of a tree do not as a rule mature uniformly, so that in most cases two or more pickings have to be made. The variation in this respect is so much an individual characteristic that the peculiarities of each tree in the case of a seedling orchard, and of each variety if budded, will have to be ascertained by test. The fruit must be removed from the tree while it is still very firm if it is to be shipped to a distant market. For local consumption the crop may be permitted to remain on the tree until a few fruits have fallen.

In picking, the avocado should be broken off so as to leave a portion of the stem attached to the fruit. If a particular variety does not break properly, an orange clipper or the ordinary pruning shears may be used. If the stem be pulled out of the fruit, as occurs in "drops," there is a strong probability that some of the fruit will be lost from ripe rot in transit, or by softening in the hands of the dealer.

GRADING AND SIZING.

With the avocado, as with all other fancy fruits, it is necessary to exercise care to have all the specimens in a crate of uniform shape and

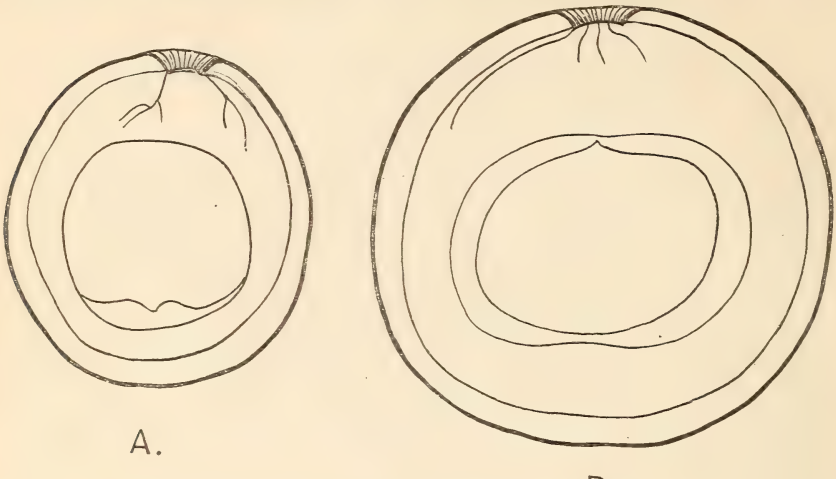

FIG. 6.—Longitudinal sections of round avocados, West Indian–South American varieties (about one-half natural diameter): A, seed filling the cavity; B, fruit from another tree of better quality, but seed loose in the cavity.

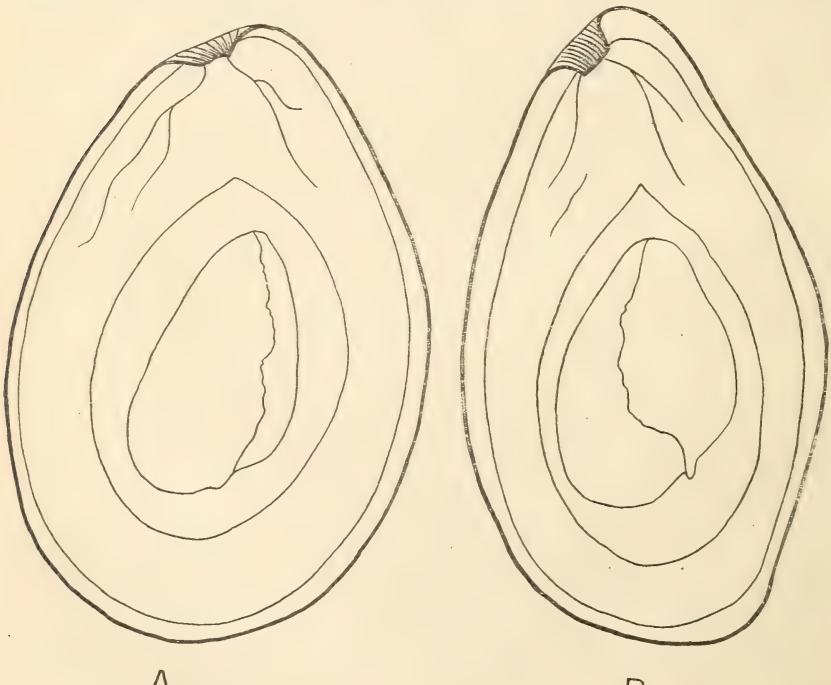

FIG. 7.—Longitudinal sections of oblong avocados, West Indian–South American varieties (about one-half natural diameter): A, small seed, loose in large cavity; B, large seed, loose in the cavity.

size. (See figs. 6, 7, 8, and 9.) A few small ones in a crate of otherwise large fruits will cause a greater loss to the seller than would have been

occasioned by rejecting the small ones. Fruits that average more than fifty to a tomato crate are not desirable for sending to distant markets. While the demand has been so strong that almost any avocado in sound condition would sell, too great emphasis can not be placed upon the necessity for packing each crate with fruit of uniform size, shape, and color.

While the market has no pronounced demand for any particular form, those of a decided pear shape (see fig. 8), of even size, and of which about three dozen can be packed in a tomato crate, bring the highest price.

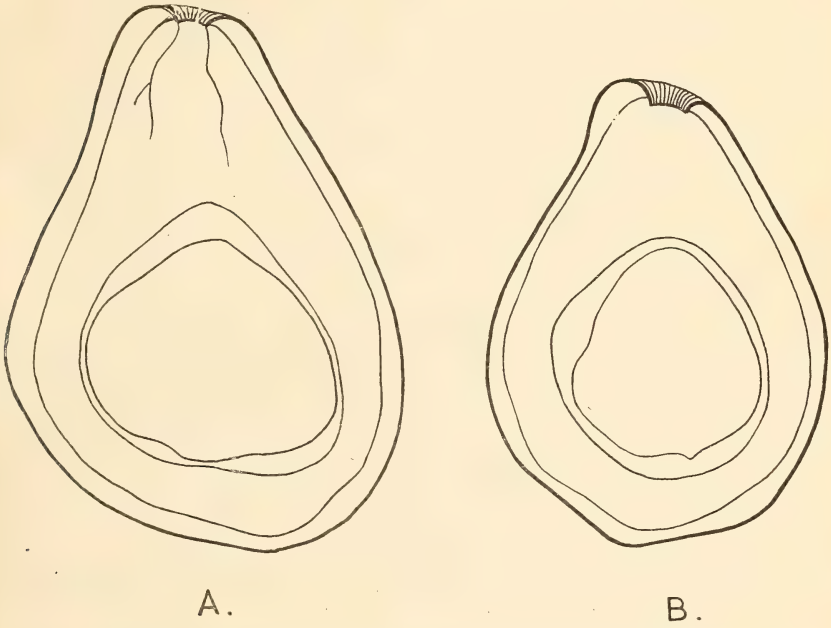

FIG. 8.—Longitudinal sections of pear-shaped avocados, West Indian–South American varieties (about one-half natural diameter): A, very large seed, loose in the cavity; B, large seed, loose in the cavity.

PACKING.

For shipping purposes the market at present demands a tomato crate or an eggplant crate. In the course of a few years a standard package of dimensions best adapted to this particular fruit will, no doubt, be adopted. Neither the tomato crate nor the eggplant crate is perfect from the growers' point of view. The larger package brings such a quantity of fruit into one compartment that some of the lower ones are likely to be bruised in transit. If some of the avocados happen to become soft on the way, the appearance of the remainder will be much injured and the selling value of the entire crate will be greatly reduced. The tomato crate is much better in these respects, but it is not entirely satisfactory, because only the round fruits pack well in it.

When the ideal crate shall be adopted it will probably be similar in shape to the boxes used for California pears.

Before packing, the individual avocado should be wrapped in some substantial and attractive paper. This will add materially to the carrying quality and to the selling price of the fruit. Enough fruit should be put into the crate so that it will be packed firmly, to prevent any possibility of shaking on the way to market. It is not always

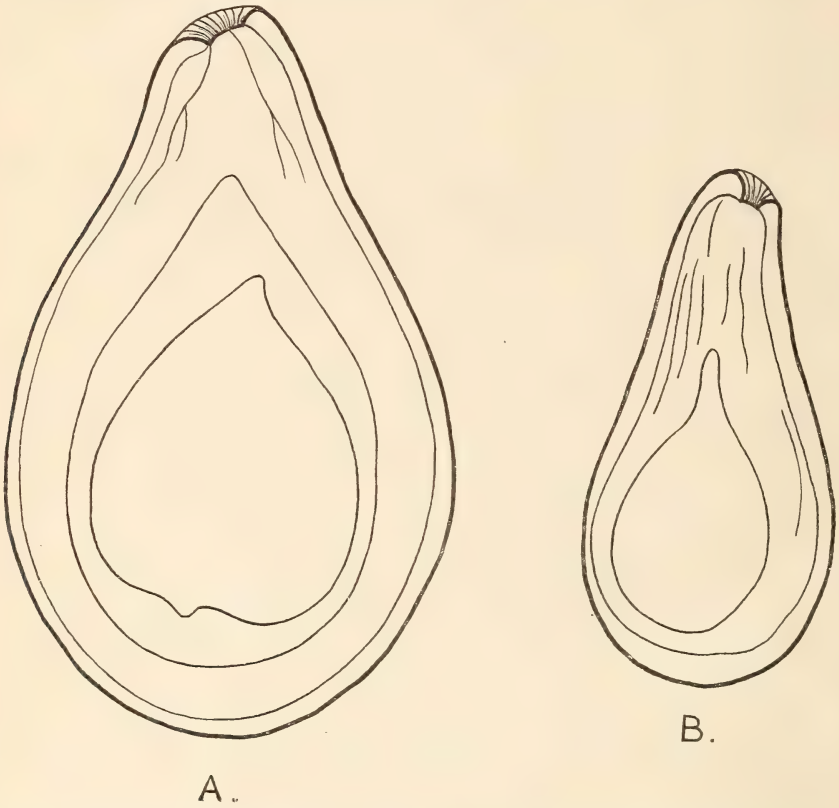

FIG. 9.—Longitudinal sections of bottle-necked avocados (about one-half natural diameter): A, West Indian–South American variety, with very large cavity; B, Mexican variety, with seed filling cavity.

possible to properly fill the crates now used, and it sometimes becomes necessary to fill up the vacant space with excelsior. In large crates and with well-matured fruit a considerable quantity of excelsior must be used to make sure that the fruit will not be bruised. The production of avocados in the United States is so limited and the demand thus far is so much greater than the supply that comparatively little care has been necessary to secure good prices, provided the fruit reached the market in sound condition.

THE FRUIT.

The avocado varies greatly as to size, shape, color, texture, and composition, while the trees also present distinct differences. In size, the fruits vary from those no larger than a hen's egg to specimens which weigh 3 pounds. (See fig. 7, A, and fig. 9, B.) As to shape, there are four recognized types, although all possible gradations occur. The so-called round fruit (see fig. 6) is not strictly spherical, being flattened at the distal end or at both ends. The oblong fruit (see fig. 7) may be of various lengths, but the diameter is always greatest from the stem to the distal end. The pear-shaped (see fig. 8) and bottle-necked varieties (see fig. 9) are sufficiently described by their names.

The color of a ripe avocado varies from a dark purple, like that of a ripe eggplant, to scarlet, yellow, and grass-green. As a rule, the fruit is not of one color over all of its surface; the purple or scarlet fruits are usually lighter and the green fruit tinged with yellow at the distal end. All combinations of the sizes, colors, and shapes mentioned are found.

THE EDIBLE PORTION.

The edible portion of the fruit, called the meat, in desirable varieties is a smooth, rich substance, with the texture of cream cheese. Some inferior fruits are decidedly watery and oily in appearance, while others are comparatively dry.

The following analyses were made by Charles D. Woods and L. D. Merrill.[a] The pulp of three fruits was taken for an analysis.

	Grams.	Per cent.
Edible portion	762.2	71.09
Seeds	201.4	19.71
Skins	94.0	9.20
Total	[a]1,021.6	100.00

[a] Thirty-six ounces.

It was found that 1 pound of the edible portion contained the following weights of nutrients:

	Pound.
Water	0.811
Protein	.010
Fat	.102
Carbohydrates	.068
Ash	.009

The fuel value is estimated at 1,758 calories per pound of edible portion.

[a] Maine Agr. Exp. Sta. Bul. 75, July, 1901, p. 111.

In color of meat the fruits of different varieties vary. Immediately under the epidermis it is green, sometimes for only a fraction of an inch; in other varieties it may be green three-quarters of the way through the meat, the remainder being either whitish or yellowish, or the green color may extend almost to the seed. Some of the finest varieties have a cream-colored meat. In texture some avocados have rather watery meat, with a number of strings running through it, and are decidedly inferior to fruit with firm meat and no strings.

SEED AND SEED CAVITY.

The variations in the seed cavity are of importance from a commercial standpoint. In some fruits the seed is lodged firmly in the meat; in others it occupies only a fraction of the cavity (compare figs. 6, 7, 8, and 9), and variations occur anywhere between these extremes. Obviously, the best shipping fruit is that with a seed cavity so small that the seed can not be shaken about, since in handling the fruit in transit the seed in a large cavity so bruises the meat as to cause rapid deterioration. This point should be borne in mind in selecting varieties for propagation.

In the shape and size of the seed marked variation occurs. The shape does not necessarily conform to that of the fruit, while the size may vary from one-half the bulk of the fruit down to one-tenth or even less. (Compare figs. 6, 7, 8, and 9.) One tree that bears seedless fruit has been discovered in Florida. Since the formation of seeds is the greatest tax on the energies of the plant, it is important for the grower to produce fruits with as small seeds as possible; these the buyer will also prefer, as to him the seed is of no value.

SHAPE OF THE TREE.

The manner of growth of avocado trees differs exceedingly. Some trees grow with a slender shape, like the Lombardy poplar; others spread out in the form of an American elm, while the greater number take on the compact shape of a fruit-bearing tree, making an outline somewhat similar to that of a haycock. (Compare Pls. I, II, and III.) This last mentioned form is, of course, the most desirable of the different shapes. It gives the tree a chance to withstand gales, and permits the fruit to sway on slender branches, thus keeping it from being blown off during storms.

FORMS AND VARIETIES.

The species *Persea gratissima* Gärtn., or what is popularly known as avocado, is well defined from the other species of the genus, but inside of the species as at present understood it is exceedingly variable. Some attempt has been made to separate this species into varieties, but so little has yet been done in the way of perpetuating

particular sorts by bud propagation that varieties in the pomological sense have not yet found a place in literature. La Sagra[a] gives the following classification, based upon the characters of the fruit:

The aguacate is, without doubt, one of the most valuable fruit trees of South America. The fruit is in form of a large pear, without any depression at the head. The skin is a yellowish green or a pale violet color, and smooth. The substance of the fruit, when well matured, is nearly white and has a soft, oily consistency and a slightly sweet taste, somewhat sugary. It is eaten in its natural state and also seasoned in various manners, nearly always with a little salt. The animals devour it eagerly.

The tree blossoms in April and the fruit matures in July and August. The varieties which are cultivated in Cuba are—

1. The violet color, which is nearly round in shape.
2. The large green, round, with the inside yellowish and having the consistency of bread.
3. The large yellow, similar to a large pear.
4. The long green.

The maturity of the fruit is known when the seed which it contains becomes loosened from the substance of the fruit and rattles when it is shaken.[b]

In order to obtain good trees one must sow the seed in the place where it will remain permanent, in holes of 3 feet in dimension in every direction, which are filled with good soil.

These trees ordinarily bear fruit from the fifth year and live to about their eightieth year. They are planted in form of beautiful groves and walks about the dwellings of the inhabitants, and as their growth is very vigorous they soon take strength from neighboring trees. Their flowers yield a very agreeable perfume.

Compare the description of plates, page 36, and figs. 6, 7, 8, and 9 with the above description.

Meissner[c] recognizes several botanical varieties based upon the shape and size of the leaves. *Vulgaris* has leaves "3–4 poll" by "1½ poll;" *Oblonga*, "4–9 poll" by "$\frac{5}{4}$–2 poll;" *Macrophylla*, "6–9 poll" by "3½–4½ poll."

THE MEXICAN AVOCADO.

There is a small-fruited form of avocado which was introduced in 1893 from Mexico (see fig. 9, B) in the form of seeds by the Division of Pomology of the Department of Agriculture, to which no reference is made in the literature examined, and no specimens of this form were found in the herbaria visited. It is regarded in Mexico as more frost resistant than the common form found in Florida and the West Indies, but is not considered as valuable as the larger fruited varieties where the latter may be grown successfully. Its fruit is pear-shaped, or bottle-necked, about the size of a hen's egg, usually of a dull blackish or bluish color. The skin of the fruit is thin and leathery. The seed is small, conical, usually about an inch in diameter.

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[a] Translation from Historia Fisica de Cuba (1845), Vol. XI, p. 186.

[b] Correct for some varieties only.—P. H. R.

[c] Martius, Flora Brasiliensis, Vol. V, pt. 2, fasc. 41, p. 159.

The tree is a less vigorous grower, and the branches are inclined to be slender. The leaves are borne on a slender petiole about half as long as the blade, which is thin and elliptical in shape. The flowers are borne in an open panicle on long slender pedicels and the fruit ripens earlier than the West Indian–South American form.

Another striking peculiarity of this form is that the first pair of scale-like leaves produced have, while those of the West Indian–South American form do not have, a distinct petiole and blade. (See fig. 1.) This form has been grown successfully in California, where it is becoming popular. Figure 9, B, is from a specimen kindly furnished by Mr. W. Chappelow, Monrovia, Cal., from a tree grown from seed of the first importation from Mexico by the Department of Agriculture.

THE WEST INDIAN–SOUTH AMERICAN AVOCADO.

The fruit of the West Indian–South American avocado is large, varying in weight from a quarter of a pound to 3 pounds. The shape is as variable as the size, varying from oblate spheroidal to almost banana shaped. (See figs. 6, 7, 8, and fig. 9, A.) The color of the fruit is purple, scarlet, yellow, and green. The rind is usually thick and brittle. The seed is often very large, sometimes making up one-half the weight of the fruit; the shape of the fruit variable—spheroidal to conical. The tree is of vigorous growth, reaching a height of 20 to 30 feet, and sometimes is even taller; the branches are thick and brittle. The leaves are borne on a short, thick petiole, less than one-fourth the length of the blade, which is thick, elliptical, and from 4 to 10 inches long. The lower surface of young leaves is covered with a pubescence. Flowers in open panicle are borne on a short peduncle. The fruit is borne on a thick pedicel, and ripens from the middle of July to December. A few trees retain their fruits until January, and even up to March.

In the native habitats the species seem to run to distinct forms, as is indicated from the botanical literature and botanical specimens named by authorities on the subject. These forms do not come true to seed when brought into cultivation, owing probably to the fact that the trees are put under special new conditions, and that trees from a large number of varieties are planted near to each other, making cross-pollination almost certain. It is not surprising, therefore, that we find large-fruited and small-fruited trees; yellow, green, scarlet, and purple colored fruit; small, medium-sized, and large leaves; good, bad, and indifferent qualities, all coming from selected fruits from a single tree, as indicated from observations cited on a former page. It is really only what should be expected when viewed from a plant breeder's standpoint.

THE IDEAL AVOCADO.

The tree should be of small or medium size. So long as the supply is limited and the fruit brings fancy prices, the cost of gathering from the tall-growing trees is no serious obstacle, but much fruit is lost from a tall tree as a result of high winds, which are common in the Antillean region during the ripening season.

The fruit should weigh about a pound to a pound and a half. This is large enough for persons with an ordinary liking for this fruit, while those who are extraordinarily fond of it can call for two fruits. Pear-shaped (see fig. 8) or oblong varieties (see fig. 7) should be preferred, as they can be packed readily and transported without much danger of being bruised in transit. The seed should not be loose in the cavity, as the shaking of it in transit pounds the meat into an unsightly mush. The color of the fruit should be either yellow or scarlet. The fruits that ripen green are considered by the novice as having been picked when too immature, and those that ripen brown or purple look as if they were in the first stages of decay. A very late variety would undoubtedly be the most desirable, since it would ripen at a time when all the West Indian and Mexican avocados were gone, and most of the northern fruits were out of the market.

USES OF THE FRUIT.

According to Patrick Brown,[a] horses, cows, cats, dogs, as well as all sorts of birds, feed on this fruit.

Much has been written regarding the manner of serving this salad fruit, but only one or two essential additions have been made in the last two hundred years. No matter how daintily it may be prepared one can scarcely relish it more than when, tramping through the forests, he happens upon a tree with a few fruits fully matured. The traveler is likely to be seated at once, enjoy his fruit without salt, sugar, or other condiments, and forever after he will remember the deliciousness of that particular fruit, which if eaten with any or all condiments at the most carefully appointed table would not have made as strong an impression on his memory.

An avocado should not be used until the meat cuts smoothly with a teaspoon and is about the consistency of well-frozen ice cream. No one should attempt to eat the fruit after it has softened; a rancid avocado may well be compared to rancid butter.

The simplest way of using this fruit is as already stated. One merely halves the fruit, removes the seed, and dips out the meat with a teaspoon, or to the plain fruit a bit of salt may be added. Some people use pepper in addition. The number of ways in which the

[a] Civil and Natural History of Jamaica, London, 1789, p. 214.

avocado may be served is as varied as the possible salad combinations. One should not, however, deluge this rich fruit with oil nor overpower with condiments its mild, nutty flavor. Salt, pepper, and vinegar are often used; if to this enough sugar be added to take off the sharpness of the vinegar, it will be an improvement. Lime juice or lemon juice may be substituted for the vinegar with advantage. The avocado is sometimes served as a dessert with sugar and sherry.

Another distinct method of using this fruit is to remove the meat from the skin, add the condiments desired, and then stir the whole into the form of a salad and serve either alone or on lettuce leaves. Some chefs cut the meat into small cubes of about a half or one-third of an inch in size and serve it with condiments, as in minced salad.

The use of the avocado as an ingredient of lobster or other shellfish salad is said to have become quite general in localities where the fruit can be obtained, as it gives the salad a pleasing nutty after flavor not otherwise secured.

Another use is in mixed pickles. For this purpose the fruit should be selected before it has become soft, yet after it is no longer hard and brittle. The fruit is pared, the seed taken out, and the meat cut into pieces not over a half inch thick. This is then prepared in the usual manner for cucumber pickles, etc.

DISEASES.

LEAF DISEASE.

While the avocado has recently been introduced into cultivation, it has some severe diseases, which, however, can be handled without much difficulty if taken in time. One of the most prominent and common diseases noticed is due to a *Gloeosporium*, probably an undescribed species. This almost invariably attacks the leaf at the tip, and gradually works back from this point into the blade. By the time the leaf has become two-thirds or three-quarters diseased, it usually falls off, and in this way the fungus may defoliate the entire tree.

Remedy.—Spraying with Bordeaux mixture[a] should be begun on the first appearance of the trouble. If spraying is delayed until the tree has been partially defoliated, success will be attained with much greater difficulty.

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[a] Bordeaux mixture may be prepared by dissolving 6 pounds of bluestone in 25 gallons of water. This may be done readily by placing the bluestone in a feed sack and suspending it near the surface of the water. Slake 6 pounds of lime with just enough water to cover it. When this has been thoroughly slaked, dilute with 25 gallons of water. Strain the slaked lime into the tank of the spraying machine through coarse sacking, to remove all particles which might clog the spraying machine. Pour the dissolved bluestone into the lime water, stirring vigorously for two or three minutes. Apply at once.

FRUIT DISEASE.

Apparently the same fungus which causes the disease of the leaves attacks the fruit in various stages of development. If the disease becomes prevalent while the fruit is small, it will shed off until the tree is quite fruitless. If the disease attacks the more mature fruit, it is liable to remain on the tree until nearly ripe, but the fungus produces a brown spot, and finally the skin cracks.

Remedy.—The same remedy should be used as for the leaf fungus.

SUMMARY.

Avocados do not come true to seed.

Orchards of seedling trees can not be relied upon to produce good crops.

Budding is practicable and it is the most desirable way of propagating.

Crown-working is preferable to top-working.

Budded trees grown in a nursery should be used in planting an orchard.

All the fruit shipped to market in a crate should be of the same size, of the same shape, and of one color.

Preferences for color are as follows: Yellow, scarlet, green, brown.

Pear-shaped fruits and oblong shapes are preferred. Round are less desirable than bottle-necked fruits.

The varieties which ripen during December, or later, sell for the highest prices.

The large percentage of fat contained in this fruit makes it especially desirable, since it is much more agreeable to some people than the fat obtained from an animal source.

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PLATES.

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.*—West Indian–South American avocado tree, about 35 years old, growing on a coral breccia reef. Produces fruits of fine quality. Ripens purple.

PLATE II. Fig. 1.—Crown-worked avocado tree eighteen months after insertion of bud. The bud was placed in a sprout that had started from a stump of a tree the summer before. West Indian–South American variety. About 8 feet tall. Fig. 2.—Top-worked tree eighteen months after insertion of bud, which was placed in a green sprout. The tree was approximately of the same age and vigor as the one shown in Plate II, figure 1. Mexican variety. About 12 feet tall. Compare the general mode of growth, arrangement of leaves, etc., with the tree shown in Plate II, figure 1.

PLATE III. Nursery tree two years old, transplanted from seed bed, West Indian–South American variety. A good, vigorous stock for budding. About 4 feet tall.

PLATE IV. Fruiting branch of West Indian–South American variety, showing the manner in which the fruit is borne upon the branches. The photograph from which this illustration was made was taken from the inside of the tree to bring out the peculiar mode of attachment. This branch may be considered as carrying a very heavy crop. Fruits about one-tenth natural diameter, ripening green.

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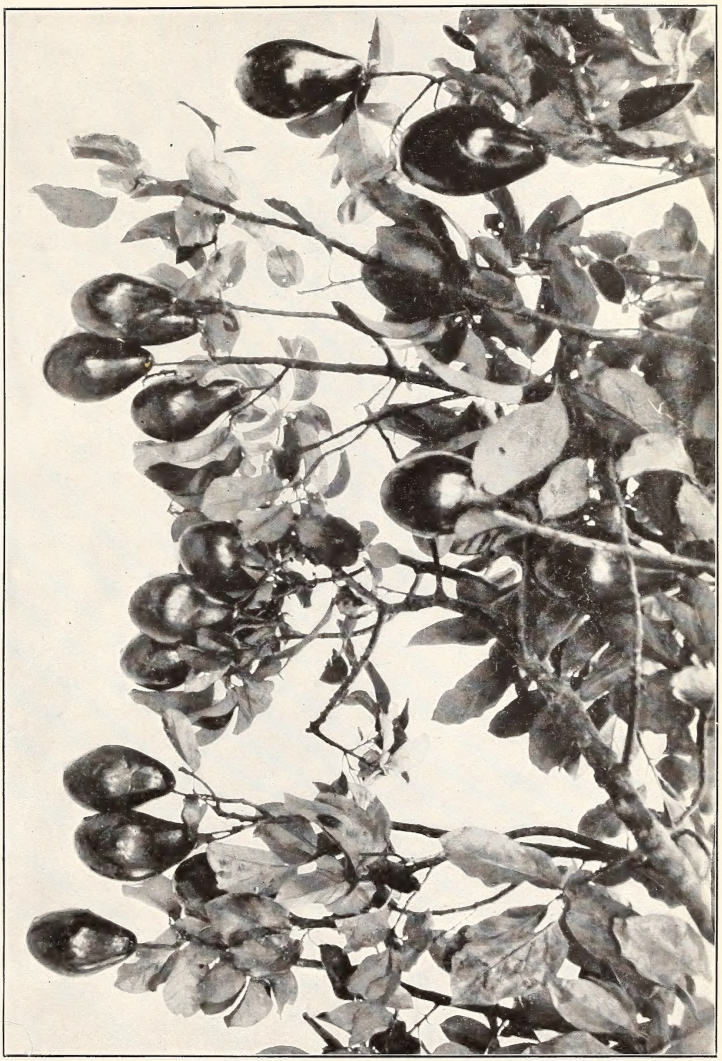
FIG. 1.—CROWN-WORKED WEST INDIAN-SOUTH AMERICAN AVOCADO TREE, EIGHTEEN MONTHS AFTER INSERTION OF BUD.

FIG. 2.—TOP-WORKED MEXICAN AVOCADO TREE, EIGHTEEN MONTHS AFTER INSERTION OF BUD.

WEST INDIAN-SOUTH AMERICAN AVOCADO TREE IN NURSERY, 2 YEARS OLD, 4 FEET TALL.



FRUITING BRANCH OF WEST INDIAN-SOUTH AMERICAN AVOCADO TREE. (ONE-TENTH NATURAL SIZE.)

[Continued from page 2 of cover.]

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56. Nomenclature of the Apple. [In press.]

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60. A Soft Rot of the Calla Lily. [In press.]